Glacial Isostatic Adjustment: Evidence from combination of GNSS and Gravimetry

Hans-Georg Scherneck (1), Martin Lidberg (2), Jan M. Johansson (1), Per-Anders Olsson (2), Jonas Ågren (2)

(1) Chalmers University of Technology, SE-412 96, Göteborg, Sweden
(2) Lantmäteriet, SE-801 82 Gävle, Sweden

hgs@chalmers.se

Sixteen years of BIFROST have provided access to reliable measurements of deformation. Remaining weaknesses are rather to be found in terms relating to reference frame issues, these terms cause side effects on deformation if unadjusted, but adjusting frame translations and rigid rotations, they are completely separable from deformation. Unfortunately, the weakness of the frame parameters implies that estimates of sea-level change are biased, but on the other hand, this bias pertains to spherical harmonic degree 1; it needs to and can be addressed in a global approach.

Far longer has the project been conducted which, with coordination from the Nordic Geodetic Commission, is to determine the gravity change in the rebound area. Apart from aiming at a precise determination of geoid change, an expected outcome are constraints for the inference of mantle structure and rheology. The ratio of gravity change to uplift rate has for long been pointed out as an indicator for the mantle density of the competent layers in the uplift. We will show, however, that the g/u-ratio despite of its observational accessibility, represents an ill-posed problem. The ratio is wavelength dependent. Therefore it its spatially variable, and not only depends on density but also on the depth of the competent layer and on the dominant wavelength of the load.

Generally, the g/u ratio decreases when the dominant wavelength of the load increases. The dispersion curve of relaxation times shows that long wavelenths in the rebound adjust more slowly, so that the g/u-ratio decreases with decreasing upper-mantle viscosity, despite the competent layer having a lower density than e.g. an isoviscous mantle. These findings cannot be reconciled with simple Bouguer concepts. However, some of the wavelength-dependent features can be demonstrated already in a plane model with an elastic lithosphere atop a fluid half-space under a finite (e.g. bell-shaped) load.